Role of IPPs in Energy Sector of Pakistan, Comparison with Different Countries and Policies to Ensure Positive Role

Muhammad Ali Afzal

NUST-2012-60724-MCES-64112-F

Session 2012 – 2014

Supervised by

Dr. Mohammad Bilal Khan

This thesis is submitted to the Center for Advanced Studies in Energy in partial fulfillment of the requirements for the degree of

MASTERS of SCIENCE in

ENERGY SYSTEMS ENGINEERING

Center for Advanced Studies in Energy (CAS-EN)

National University of Sciences & Technology (NUST)

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Certificate

This is to certify that the work in this thesis has been carried out by **Mr. Muhammad Ali Afzal** and completed under my supervision in Center for Advanced Studies in Energy, National University of Sciences & Technology, Islamabad, Pakistan.

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Principal/Dean	_____ Dr. M. Bilal Khan Center for Advanced Studies in Energy NUST, Islamabad

I dedicate my efforts to my parents and teachers.

Acknowledgements

First and foremost, I would like to extend my sincerest gratitude to my thesis supervisor, Dr. Mohammad Bilal Khan, he possesses the talent to enter into the minds of those who like to make a fresh approach to the sources of technical knowledge.

I am very much thankful to Miss Najia Khan (House of Synergy) for providing me with a wonderful opportunity to work under her tutelage and guidance. Her advices and suggestions had been a constant source of motivation and learning during my research period.

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Finally, I owe my deepest gratitude to my friends and family members whose unconditional love, absolute affection, infinite trust and endless confidence inspired me to complete my work.

Abstract

Country is facing severe shortfall of electricity since three decades so to minimize this issue private investors were welcomed in power sector back in 1990's after the formation of 'Power Policy 1994'. After starting operations of IPPs in 1997, there was a tremendous increase in generation capacity and it was enhanced to 74% just in 5 years. Electricity was totally sold to WAPDA under 25 years PPA (Power Purchase Agreement). Until now there are almost 30 IPPs in operation and contributing nearly 37% in Country's electricity generation. Presently all IPPs are thermal and most are consuming RFO (Residual Fuel Oil), few are Diesel based and rest are using Natural Gas. In this research a comparison of Pakistan with three countries India, Taiwan and Indonesia is made and share of IPPs in these countries is investigated. On the basis of this comparison, few policy recommendations are proposed for exclusion of power cut from country. At this time there should be very indulgent policies regarding private investments in Pakistan. Coal fuel must be promoted as bordering countries are consuming around 60% coal fuel in their electricity generation. Similarly, renewables especially Wind Power should be fostered in Electricity Sector. GENCOs (Government owned generation companies) are running at very low efficiencies, there is need for policy revivals for GENCOs to minimize fuel consumption and for better efficiencies.

Keywords: IPPs; Policy; Power generation; Energy; Shortfall.

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List of Figures

List of journal/conference papers from this work

Journal Article

1. Muhammad Ali Afzal, Hamid Iftikhar, Dr. M. Bilal Khan, Najia Khan, Asad Muneer, Ali Uzair

   "Current Scenario of Independent Power Producers in Power Sector of Pakistan".[1]

   Under review in journal "Journal of International Academic Research for Multi-disciplinary" with an impact factor of 1.625.

[1] Attached as Annexure I.

Chapter 1

Introduction

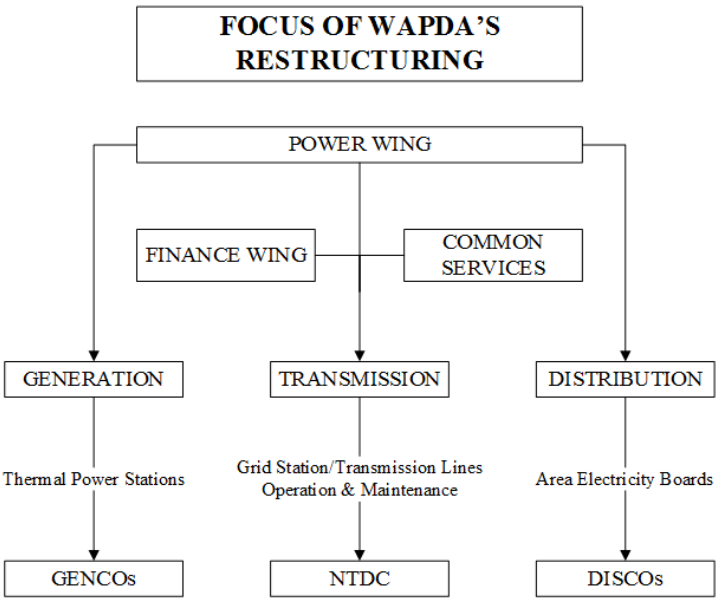
1.1. Background

Electricity is taken as life line of every economy and one of the vital tool of socioeconomic growth of a state. Electricity is essential in operating industrial units, lightening of cities and running appliances. A challenge of sure electricity availability for industrial sector and provision of improved access to the meager areas of population is significant problem for a government. As a result of Industrial development and population growth the demand of electricity has been increased in comparison to improvement in electricity production. Supply is far less than demand that's the reason of blackouts in Country. Electricity infrastructure of Pakistan is underdeveloped and poorly managed. Presently severe Energy crisis are being faced by the Country. In spite of strong economic growth and rising energy demand during past decade, there is a little growth in generation capacity. Furthermore, rapid growth in demand, transmission and distribution losses, and seasonal declines in the hydropower has made situation worse. So the demand surpasses supply and thus power cut down becomes common phenomenon. The crisis worsened in 2008 when shortfall reached around 4,000 MW[1]. Industrial customers met power shortage due to low water level in dams while electricity prices were continuously being increased. This resulted in a great loss to industrial sector people and jobs were cut down.

1.2. Power Sector

Electricity Sector of Pakistan comprises Generation, Transmission and Distribution. Generation is a mix of hydel and thermal divisions controlled by two vertically unified utilities WAPDA (Water and Power Development Authority) for all Pakistan excluding Karachi and KESC (Karachi Electric Supply Corporation) for Karachi and it's nearby. There are several IPPs (Independent Power Producers) that share in electricity generation in country. Since a long time, the problem of corresponding Pakistan's generation compared to the demand for power has remained an unsolved matter. Country is facing an extensive challenge in making over its system in authority for the

supply of electricity. Because of an impractical tariff, inefficiencies, small payment recoveries and the failure of the government to manage its subsidies structure that lead to a serious "Circular Debt" issue which is becoming a hurdle for upcoming investments



in power sector.

The economy is being affected seriously by power crisis with loss of enormous capital. Solution to the present crisis lies in energy management at all levels in country. The practice of alternate energy e.g. Wind and Solar Power could be utilized to instantly cut the shortages, while power projects from coal and hydel can provide a lasting solution to the power shortage.

1.3. Structure of Power Sector

After restructuring of Power Sector in year 1998, PEPCO (Pakistan Electric Power Company) was formed. Before this, KESC and WAPDA were feeding the country. Afterwards, power wing of WAPDA was changed into separate bodies containing of 4 GENCOs, 1 TransCO (NTDC) and 10 DISCOs [2]. DISCOs distributes to end

Figure 1.1: Power Sector restructuring in Pakistan

consumers, KESC manages the generation section and buys rest from NTDC, IPPs and Karachi Nuclear Power Plant. Figure 1.2 elaborates the current Power structure.

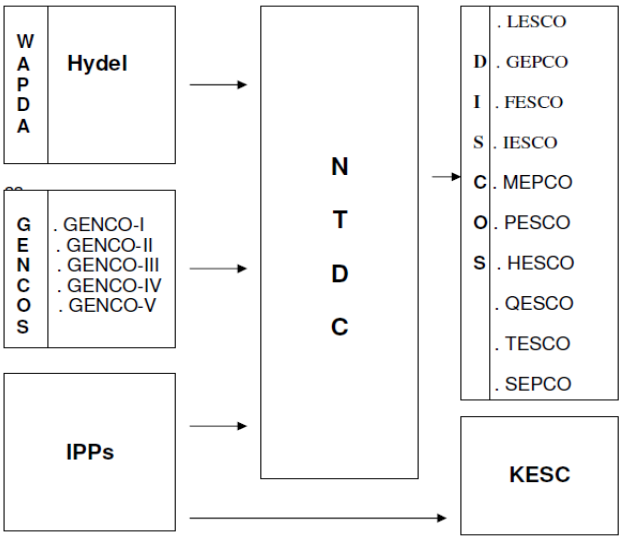


Figure 1.2: Structure of Power Sector of Pakistan

1.4. Sources of Electricity

1.4.1. Thermal

Thermal generation capacity of country is more than 15,000 MW which means more than 65% in generation mix; these plants are being running at low efficiencies and are expensive in operation and maintenance. Thermal GENCOs are running at very much low efficiencies while most of the IPPs are furnace oil based which has become an expensive fuel over recent past. The furnace oil is imported and heavy amount of foreign reserves are spent on it. Some power plants also use natural gas as fuel but a severe shortfall of natural gas has also been started.

1.4.2. Hydro

Hydro power is produced by using turbines which convert potential energy of water into electricity. Pakistan have rich reserves of hydel energy, however only 28% of total generation being generated from hydropower. At present we have installed capacity of 6,627 MW while potential is around 45,000 MW [3].

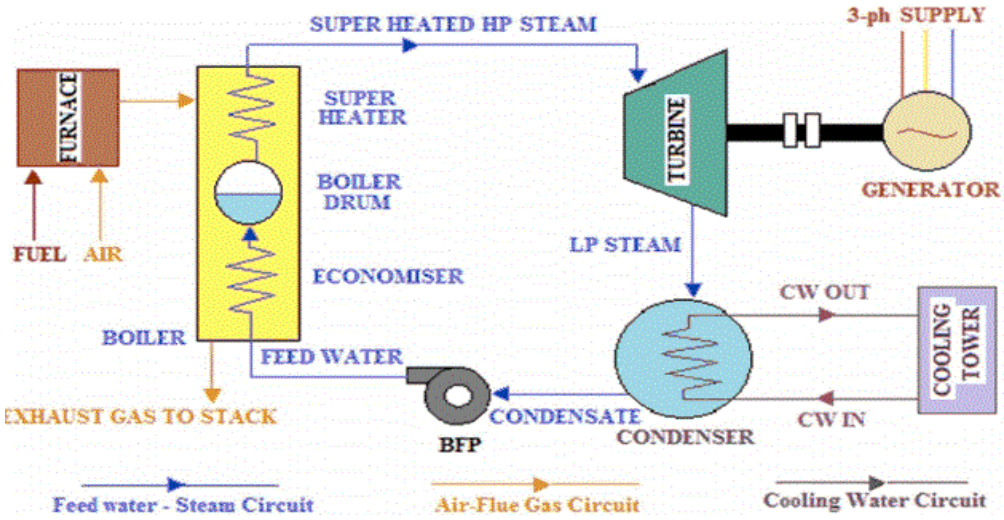


Figure 1.3: Working principle of a Thermal Power Plant

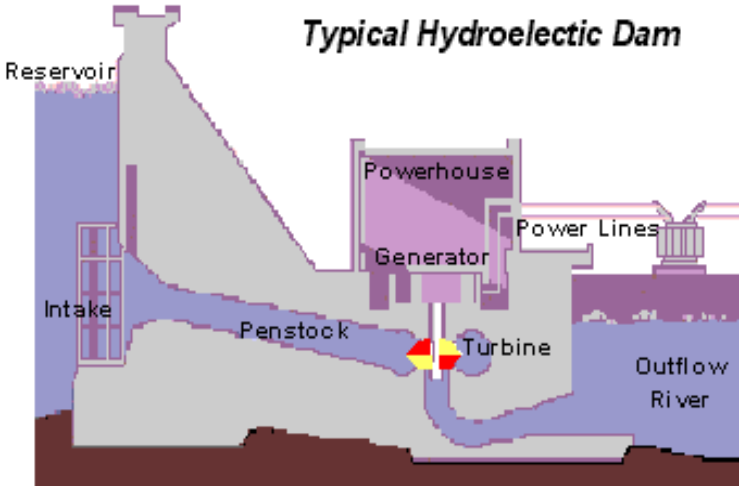


Figure 1.4: A typical Hydroelectric Dam

1.4.3. Wind

Wind power couples the energy of winds to drive the wind turbine blades. These turbines makes the magnetic rotation which generates electricity. Pakistan has wind potential of more than 50,000 MW but still wind power generation is going through preliminary phases and at present only 6 MW has been set up in first stage in Jhampir by a Turkish firm and 50 MW will soon be installed [4]. More wind plants are planned to be constructed in coastal areas of Sindh.

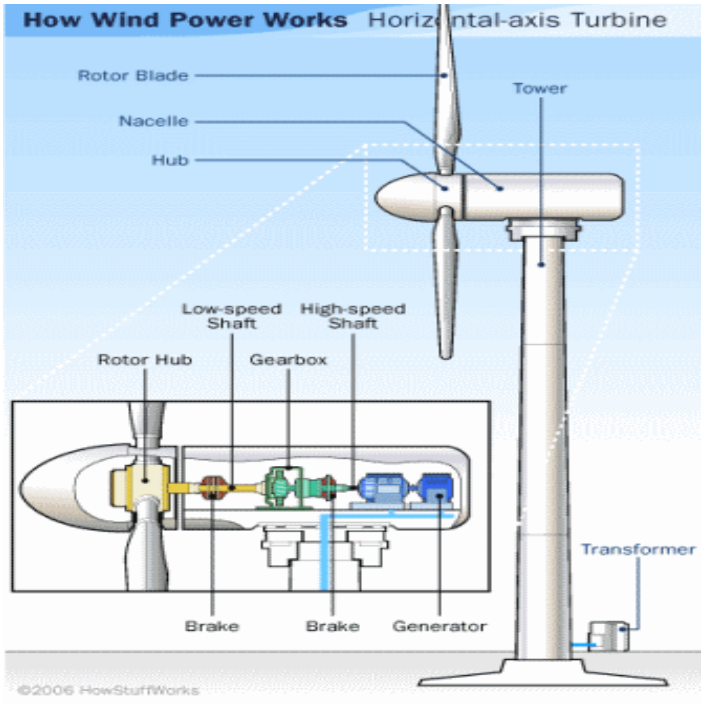


Figure 1.5: A typical Wind Turbine

1.4.4. Nuclear

In Nuclear Power Stations, fission reaction is done for generation of electricity. Pakistan doesn't have a large nuclear program and capacity is around 787 MW but plans are there for increasing the capacity significantly. Though Pakistan is freestanding from the Nuclear Non-Proliferation Treaty, hence is excluded from line of work in nuclear plant and materials and this obstructs the progression of nuclear energy.

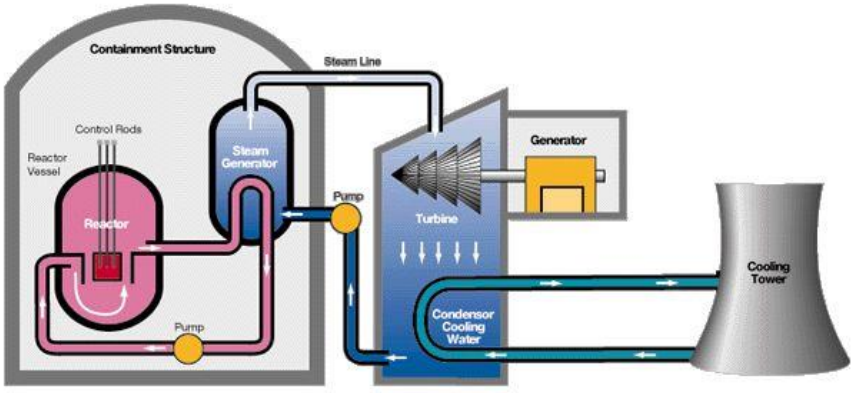


Figure 1.6: Working principle of Nuclear Power Plant

1.5. Total Installed Capacity in Pakistan

Total installed capacity of Pakistan till June 2012 is 23,246 MW. Share of Hydro Power is 6,627 MW, Thermal (GENCOs) are sharing 7,166 while IPPs are sharing 8,666 MW [3].

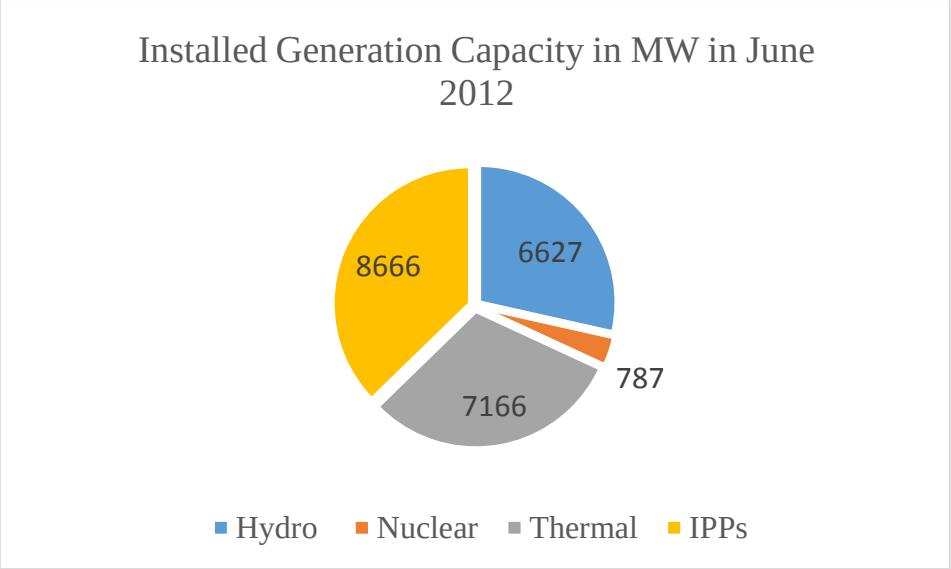


Figure 1.7: Total electricity installed capacity in Pakistan

Summary

Energy has great importance in economy of every country and essential for growth, so it is duty of government to make sure the supply of power to all consumers that includes domestic, commercial, and industrial consumers. Electricity in Pakistan is produced from different sources that includes thermal mainly i.e. 65% and remaining comes from hydel and nuclear 31% and 4% respectively. In Pakistan, like other countries electricity generation is owned by both public and private sector. Country is absolutely depending on conventional resources and share of renewables is negligible. The total installed capacity by June 2012 was 23,246 MW.

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[1] A. Malik, “Power Crisis in Pakistan : A Crisis in Governance”

[2] I. Chamber and O. F. Commerce, “An Overview of Electricity Sector In Pakistan.”

[3] N. Transmission, “COMPANY,” 2013.

[4] N. Transmission, “Power system statistics 2011-2012 37,” 2012.

Chapter 2

Literature Review

2.1. Independent Power Producers

Independent Power Producer (IPP) or Non-Utility Generator (NUG) is a non-public entity that produces electricity which is then sold to Government usually on basis long term agreement termed as Power Purchase Agreement (PPA) or sell to end users. IPPs may be privately held facilities, companies, cooperatives such as rural solar or wind energy producers, and non-energy business concerns capable of feeding excess energy into the system.

2.2. Types of IPPs

IPPs are mainly of two types, Renewable and Nonrenewable. In Pakistan almost 37% share is held by IPPs in power sector but almost all are nonrenewable i.e. that operates on fossils mainly diesel, RFO and natural gas. Renewable Independent Power Producers or RIPPs includes mainly hydro, wind, solar, and biomass. Decision of types of IPPs mainly depends upon policies of country and available resources and technology. For the past few decades, RIPPs are gaining importance because of the environmental issues related with conventional power plants. María J Martín et al have well explained air pollution related with the fossil based powered plants and have also done air pollution modeling for power plant environment [1]. Matjaž Knez et al have explained the sustainable approach to greener environment by solar power plants and highlights the use of alternative renewable energy sources [2]. Swarnalakshmi Umamaheswaran el al have explained the significance of financing in large scale wind and solar projects and also highlighted that renewable energy can play a vital role in any country in meeting the country's growing energy demands, as well as contending with climate change. Ioannis N. Kessides has analyzed the structure, conduct, and performance of Pakistan's electricity sector and also examined the causes and economic impacts of Pakistan's electricity shortages and also identified the potential policy response to the power crisis [3]. Hassan Qudrat-Ullah examined Pakistan's experience with electricity reforms

relating to the various energy policies indorsed in Pakistan over the past few decades and the analyzed effects of privatization overall and in investments in IPPs in particular [4]. Khanji Harijan et al presented an assessment of per unit cost of electricity generated from 15 MW wind farm at 40 locations in the coastal areas of Pakistan using the method of net present value analysis and study concluded that at most of the locations especially in Sindh province, wind power is competitive to conventional grid connected thermal power even without considering the externalities [5]. In another study by Khanji Harijan at al, cost of wind and conventional thermal plants was compared and result was that the cost of wind energy was lowest with Rs. 3/kWh. It was concluded that the wind power is cost-competitive to the conventional thermal power plants in Pakistan. The cost estimation for wind energy is lowest of all others with Rs. 3/kWh. Zeineb Abdmouleh reviewed the policies that encourages renewable energy and the study emphasized on the different tools to establish an encouraging monitoring framework for renewable energies and examined examples of both successful and unsuccessful experiences through the case studies and examination of different countries [6].

Summary

The literature review related to the topic is being carried out in which the main focus was on the paper describing the role of IPPs in Power Sector of Pakistan. In Pakistan a lot of encouraging work is being done in order to implicate policies regarding RIPPs, the main focus of the researchers is to benefit government by energy at minimum cost. The papers above explain the overall scenario of IPPs, policies regarding IPPs and significance of RIPPs. The benefits of introducing RIPPs in Pakistan are specially discussed that how much the improvement in sustainability and energy can be achieved by RIPPs.

References

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Chapter 3

Role of IPPs in Power Sector of Pakistan

3.1. IPP Sector in Pakistan

The IPP is a nonpublic utility which sell generated electricity to utilities and end users. In Pakistan IPPs share a lot in energy mix and it's about 37% of the installed generation capacity. IPPs were started under 'Power Policy 1994' and the era of 1992-1996 was of IPP boom in Asia. After start of commercial operation of IPPs in 1997 the generation capacity was enhanced up to 74% in just 5 years [1]. Independent Power producers adds considerably in power generation but unfortunately the energy which is being produced is below capacity because of capital unavailability caused as a result of unpaid receivables from PEPCO.

3.2. Framework of IPPs

Like other countries, here also IPPs faces sole purchaser marketplace. Power from IPPs is sold to Water and Power Development Authority. A tariff from IPPs in negotiated with the regulator NEPRA under the transparent competitive bidding procedure. Investors are normally insulated from fundamental financial hazards by signing long term Power Purchase Agreements with take-or-pay agreements supported by explicit guarantees from government and credit enhancements. The key role of the framework is to avoid the maximum risks borne by the Project Firm. A fundamental assumption is to obey the terms of their contracts of all parties.

3.3. List of IPPs in Pakistan

IPPs in Pakistan are listed below along with Generation capacity and type of primary as well as secondary fuel. The generation capacity is the nameplate capacity in Megawatt units.

Table 3.1: List of IPPs in Pakistan

Name	**Generation Capacity (MW)**	**Fuel type Primary/alternative**
KAPCO	1,638	Gas (FO, HSD)
HUBCO	1,292	RFO
Kohinoor (KEL)	131	RFO
AES Lalpir	362	RFO
AES Pak Gen	365	RFO
SEPCOL	135	Gas
Habibullah Coastel	14	Gas (HSD)
Rouch Power	450	Gas (HSD)
Saba Power	134	RFO
Fauji Kabirwala (FKPCL)	157	Gas (HSD)
Japan Power	135	RFO
Uch Power	586	Gas (HSD)
Altern Energy Ltd.	31	Gas
TNB Liberty Power	235	Gas (HSD)
Attock generation (AGL)	165.3	RFO
Atlas Power	219.2	RFO
Nishat Power	202.1	RFO
Oreint Power	229.1	Gas (HSD)
Engro Power	233.4	Gas (HSD)
Saif Power	228.5	Gas (HSD)
HUBCO Narowal	219.2	RFO
Halmore	228.6	Gas (HSD)
Saphire	228.6	Gas (HSD)
Nishat Chunian	202.1	RFO

Libery Power	202	RFO
Foundation Power	229.8	Gas
Gul Ahmad Energy	136.2	RFO

3.4. Risks met by IPPs

3.4.1. Economic Risk

Economic risk factors are exchange rate fluctuations, inflation and budgets of finance.

3.4.2. Market Risk

IPPs can sell generated power to single customer only i.e. WAPDA. This prescribed procedure exposes IPPs to the risk of single customer. Though there are guarantees given by Government to pay off the IPPs for defaulting of WAPDA on payments and the recent crisis of IPPs reflects unwillingness of Government to honor guarantees on appeal that WAPDA could not manage to pay for outstanding IPP dues.

3.4.3. Political Risk

It states the guarantees to IPPs by government by Implementation Contract. Because of political instability, nationalization polices in the past and other similar problems, foreign investors were reluctant to invest.

3.4.4. Budget Overrun Risk

During the construction period of a power plant, one of the greatest risk arises when financers are supposed to make available all the funds up to completion of the project including all the inflated costs between financial closure and project completion.

3.5. Problems of IPPs

Two main problems faced by IPPs are:

3.5.1. Unavailability of short-term liquidity

IPPs are mainly facing the problem of unavailability of short-term liquidity. Many proposal from the advisory council of IPPs have been presented to the banks for working capital limits allocation.

3.5.2. Circular Debt

Government is unable to make available funds to DISCOs and DISCOs are unable to pay IPPs which in order couldn't make payments to fuel merchants, this is inter-corporate circular debt [2].

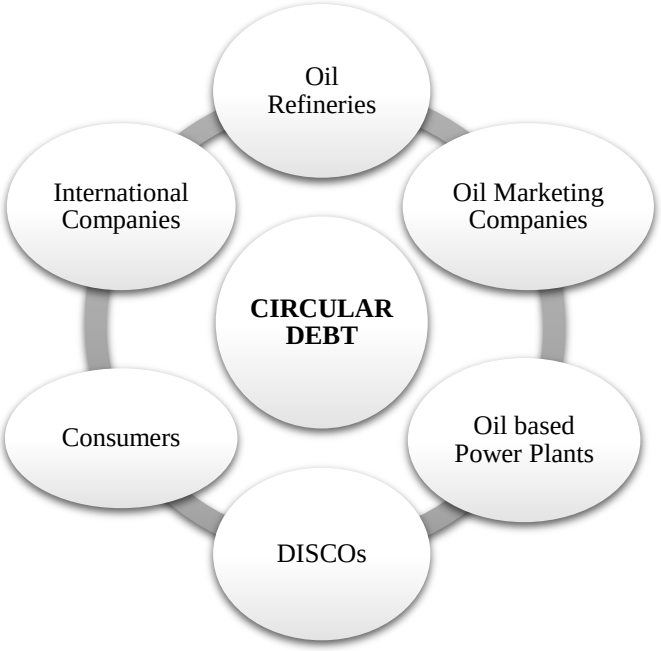

Figure 3.1: Intercorporate Circular Debt

Most of the IPPs purchase RFO and diesel fuel from PSO (Pakistan State Oil) for electricity production but it has become problematic because of lack of working capital.

The PSO is also in the loop of the inter-corporate circular debt as it both imports and supplies RFO and Diesel fuel from national refineries to IPPs and GENCOs as well.

3.6. The IPPs Tariff

The tariff charged by IPPs to WAPDA is figured out from a formula that comprises the fixed and variable costs components. Tariff comprises of two main costs;

3.6.1. Capacity Purchase Price

Capacity Purchase Price or CPP is the fixed component and it comprises:

i. Debt payments of project including interest principal
ii. ROE (Return on Equity)
iii. Operation and Maintenance fixed elements

iv. Plant insurance cost
v. Insurance cost of Forex risk

3.6.2. Energy Purchase Price

Energy Purchase Price of EPP is the variable component and comprises:

i. Fuel cost fixed by Governmental organization and overhead the global rates with surcharge amount
ii. Operation and Maintenance variable elements

3.7. IPPs Tariff Choices

The two tariff choices offered to IPPs are upfront tariff and negotiated tariff.

3.7.1. Upfront tariff

In this type of tariff mechanism, electricity produced by IPPs is purchased at some fixed rate without any negotiations and approvals.

3.7.2. Negotiated tariff

In this mechanism, tariff is determined by NEPRA through negotiation in consultation with power producer, electricity purchaser and other stakeholder (if any). While determining the tariff, following parameters are taken into account.

i. Technical Parameters
ii. Financial Parameters

The technical parameters include plant efficiencies, electrical efficiencies, availability factor of plant and transformation efficiencies etc. While financial parameters includes equity ratio, loan interest, return on equity (ROE), capital cost etc.

Summary

In Pakistan, IPPs were started under ‘Power Policy 1994’ and after starting of commercial operation, there was tremendous increase in generation capacity [3]. IPPs adds considerably in power generation but unfortunately the energy which is being produced is below capacity because of operational capital unavailability caused as a result of unpaid receivables from different organizations. At this time IPPs share a lot in Electricity mix and all IPPs are thermal and are being operated on RFO, diesel and natural gas. In Pakistan IPPs face certain problems from which main are circular debt and single buyer monopoly, due to which competition is less in this sector.

References

[1] “Role of IPPs in Energy Sector of Pakistan.” .

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Chapter 4

Comparison of Pakistan's IPPs with Selected Asian Countries

4.1. India

Officially Republic of India is an Asian country bordering with Pakistan, China, Bhutan, Nepal, Burma and Bangladesh, seventh largest country according to land, world's seventh leading economy by nominal GDP and third largest by purchasing power parity [1]. India is a nuclear weapons state and a local power; moreover it has the third largest upright army in the world and ranking ninth in armed expenses among nations. It is world's largest democracy consisting 29 states and union territories. India is a multiracial, polyglot and a society with multiple ethnicities. Also it is the homeland of wide range of flora and fauna in a multiplicity of sheltered habitats. India's modern monetary model is chiefly industrial and it is also member of World Trade Organization. India's service sector creates 55.6% of GDP, industrial division 26.3% and the agricultural division 18.1%.

According to Energy Information Administration, India's per capita electricity consumption is 753.1 kWh/year, which shows still there are electricity shortfalls and blackouts in the country and in some states electrification rate is around 80% whereas whirlwind developments are being implemented for 100% electrification [2]. India's electricity demand is mainly met by coal (almost 59%) which also causes problems regarding air pollutions. Renewables in India are truly getting prominence due to long term benefits and lesser paybacks, here below is brief overview of power sector of India, share of privately owned, state owned and central owned entities in electricity and a superficial sketch of renewable energy resources.

4.1.1. Introduction to Power Sector

Power Sector of India comprises of Generation, Transmission and Distribution. Total installed capacity by end of Feb 2014 is 237,742.94 MW [3]. Demand growth has

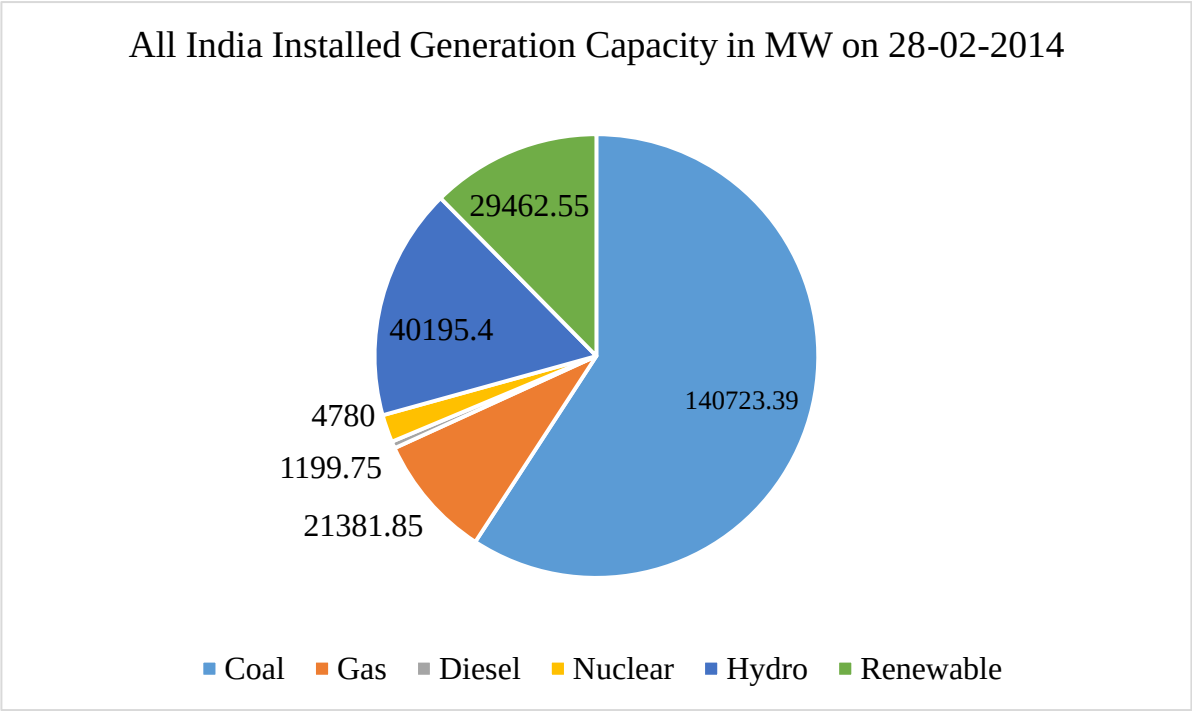


Figure 4.1: All India electricity installed capacity

surpassed the supply and country is facing power lacks in spite of multiple growth above the years. Government of India puts special importance on reduction of distribution and transmission losses and management of demand side to utilize the resources optimally. According to IEA, transmission and distribution losses in India are around 32% while world average is 14-15% Different policies initiatives and private sector participation is being done for bridging the gap of demand and supply with Mega Power Projects. The following Pie chart shows the all India Generation Capacity:

4.1.2. IPPs in India

In 1990's Government of India welcomed private investments in Power Sector and thus first IPP named Dabhol Power Plant with installed capacity of 2,440 MW was commissioned in year 2000 using Naphtha (then shifted to LNG) as fuel.

At this time almost 32% of electricity is generated from IPPs which are mostly Coal based while wind is dominating in RES. India also accelerates private investors in hydel energy and hydel IPPs are almost 3% in India. State owned entities share 90,062 MW, Central owned shares 65,732.94 MW and Private Sector shares 72,926 MW. Following

figure elaborates the percentage of state owned, central owned and private entities in India:

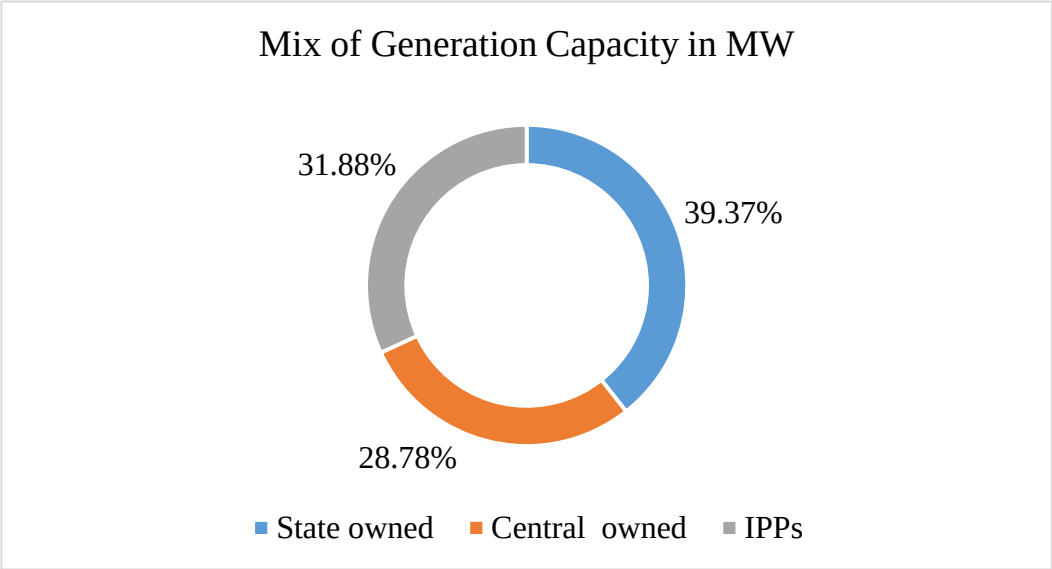


Figure 4.2: Share of IPPs in India

4.1.3. RES in India

India is the fourth largest energy consumer in the world after U.S, China and Russia so India's electricity share has notable fraction of Renewable Energy Sources (RES) as well. According to EIA, Renewable Country Attractiveness Index of India is among top 5 countries in the world. RES are sharing almost 12% of total installed capacity moreover India has world's fifth largest Wind Energy Installation with capacity 18,000 MW [4].

4.2. Taiwan

Officially the 'Republic of China' is an independent state in East Asia, bordering People's Republic of China, Japan and Philippines. It is the world's fourth highest Island. There is a still conflict in legal and political status of Taiwan between People's Republic of China and Republic of China. During second half of 20th century, there was fast industrialization and economic growth and is now an advanced industrial economy. Country changed into multi-party democracy with universal suffrage in 1980s and early 1990s also termed as "Taiwan Miracle". It is one of the Four Asian Tigers and member of World Trade Organization and Asia-Pacific Economic Cooperation. It is the 19th largest economy in the world and its advanced industry plays key role in the global

economy. Nowadays Taiwan has a vibrant export driven economy as well as gradually decreasing state contribution in investments. In observance by this trend some public banks and firms have been privatized. GDP growth has an average of about 8% in last three decades. Taiwan ranks 25th globally in terms of gross domestic product (GDP) per capita, according to 2010 International Monetary Fund data, sharing 0.65 percent of the world total in 2009 [5]. Prime impetus for industrialization has been given by exports. The trade excess is substantial and also the foreign reserves are fifth largest in the world. Taiwan also has its own currency called 'New Taiwan Dollar'.

4.2.1. Introduction to Power Sector

The Taiwan Power Company (Taipower), a vertically incorporated power service was established in 1946 and business scope consists of power sales along with generation, transmission and power distribution. It is Taiwan's one and only power sales company. The electricity produced by IPPs and cogeneration is sold to Taipower, which is then sold to the purchasers. By the end of 2011, the overall installed capacity of Taiwan touched 41,401 MW for which Taipower held 32,508 MW share and Non-Taipower held share of 8,893 MW [6]. The chief energy sources include hydel, thermal, nuclear and renewables.

Taipower is public utility bearing the duty of power supply. To come across upcoming demand and guarantee sufficient power sources, the Taipower is active in promotion of many extensive power expansion projects in the hope that generation mix of base loads, mid loads, and peak loads can be enhanced and to maintain the reasonable reserve margin target of 16%. The following pie chart shows the total Installed Capacity of Taiwan.

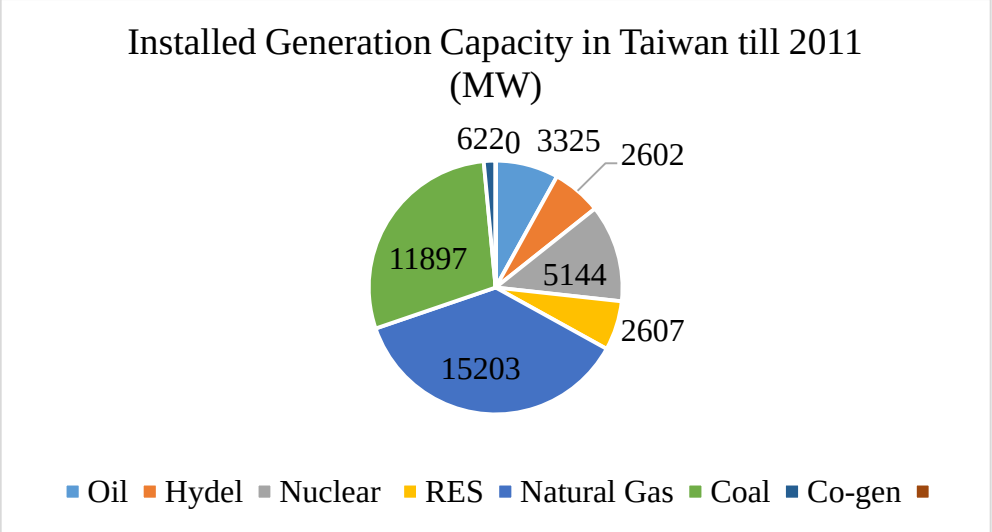


Figure 4.3: Total Electricity installed capacity in Taiwan

4.2.3. IPPs in Taiwan

The power market opened up with entrance of independent power producers (IPPs) in 1995. Presently, Taipower is the only public integrated utility with eight IPPs and other renewable energy producers as well in the market. Under such type of market arrangement, government's control over local energy prices in Taiwan has long been used as a policy tool to uphold export effectiveness and cheap domestic energy supply. Electricity underpricing has significantly distorted the behavior of energy consumers. The actual cost of purchased power therefore remains hidden from the Taiwanese consumers and very little incentives are given to implement clean energy projects to develop low-carbon arrangements in both demand and supply of energy. Presently IPPs share around 21% in the energy mix of Taiwan, most IPPs are thermal but renewable IPPs are also sharing in the mix with total contribution of 563 MW. Following graph shows the installed capacity of IPPs based on different fuels in Taiwan by the end of

year 2011.

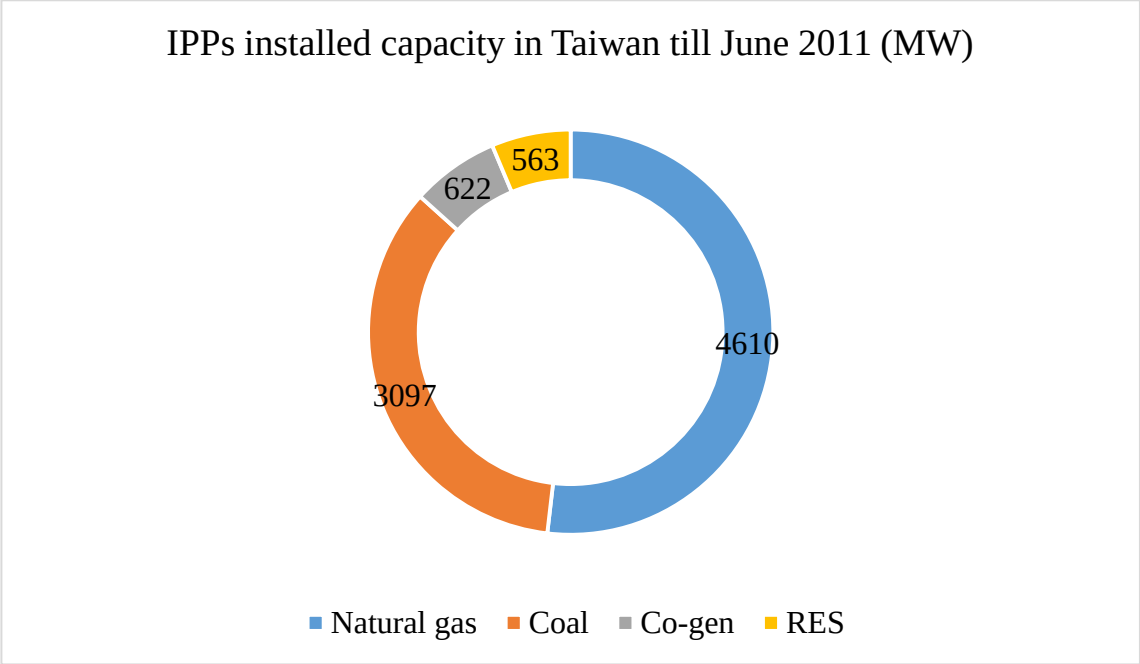


Figure 4.4: IPPs installed capacity in Taiwan

4.2.3. RES in Taiwan

The total installed capacity of Renewable Energy Resources in Taiwan is 2,607 MW, which contributes almost 6.3% in energy mix and the share of RIPPs (Renewable IPPs) is 563 MW contributing 1.4% in total share and that of public utility is 2,044 MW contributing 4.9% in total share [7]. In Taiwan, most RES are wind and solar based.

4.3. Indonesia

Officially the Republic of Indonesia is fourth most populous country in the world and largest economy in South East Asia. It is founding member of ASEAN and a member of G-20 major economies and its economy is 16th world largest by nominal GDP. It has mixed economy significantly run by both private and public sector.

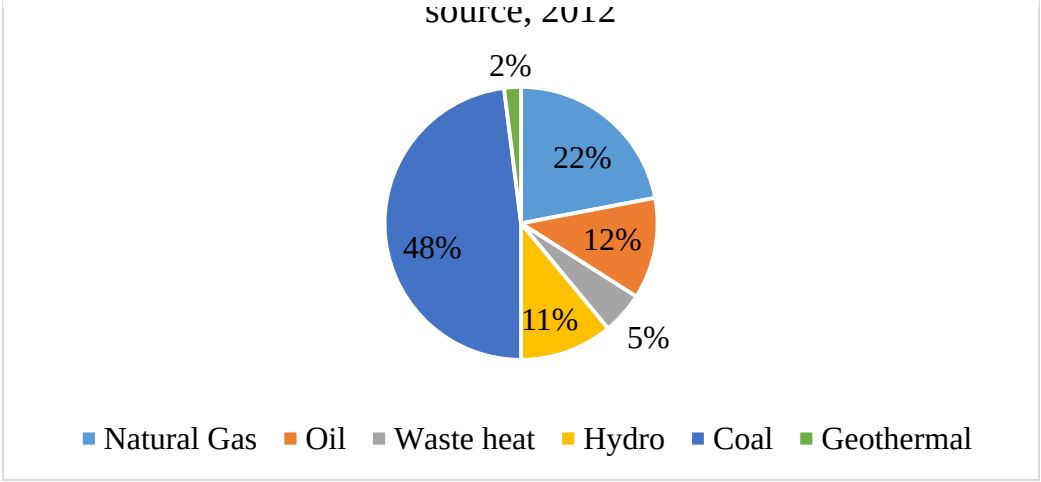
4.3.1. Introduction to Power Sector

In the power sector PLN (Perusahaan Listrik Negara) holds most of the share. It owns and operates about 85% of the country's electricity generation and also holds effective control over distribution sector while the government adjusts user electricity prices under market levels which forces PLN to take losses. In lieu of subsidizations, the government has tried to raise tariffs in the electricity sector for ensuring price security to PLN and IPPs. There are feed-in tariffs as well for power from geothermal, solar, and waste to energy. In 2012, approximately 73% of total population had availability of electricity. As of 31 March 2012, the total installed capacity in Indonesia is 36,257 MW from which PLN holds 30,868 MW while 5,389 MW is owned by IPPs [8]. Following graph shows the share of fuel in Electricity mix.

4.3.2. IPPs in Indonesia

Figure 4.5: Indonesia electricity capacity by fuel source

Figure 8: Total electricity installed capacity in Indonesia



In Indonesia IPPs holds almost 16% share in generation mix with capacity of 5,389 MW. Indonesia also allows IPPs to sell their electricity direct to the consumer and in this way single buyer monopoly can't withstand. Indonesia's 57% of total capacity of green power production will be expected from IPPs in 2019 [9]. Being oil exporter country, Indonesia still rely on Coal for power generation and most of the IPPs consumes coal, the share of IPPs and PLN is demonstrated in the following graph.

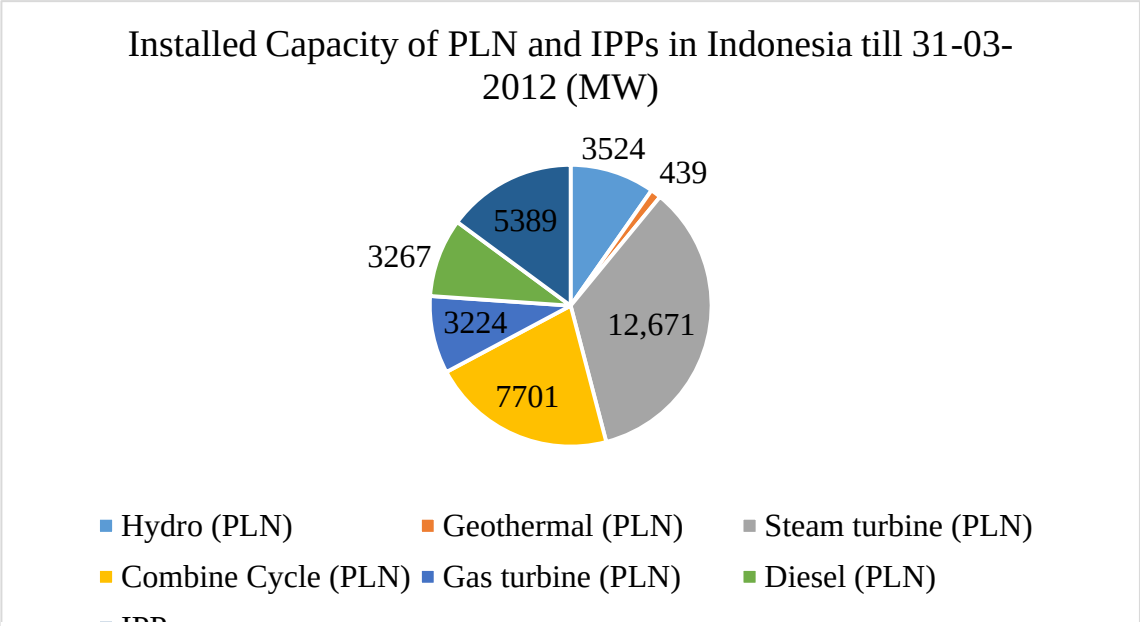


Figure 4.6: IPPs installed capacity in Indonesia.

Summary

In the comparison, three Asian countries are being considered based on GDP, per capita electricity consumption and location i.e. India, Taiwan and Indonesia. After comparing these countries with Pakistan, it can be seen that share of IPPs in Pakistan is comparable to other countries but share of Coal in Pakistan is negligible and there is certain need of coal based power plants preferably by private sector. Talking about renewables, RIPPs are very much lacking in Pakistan as compared to other countries. Pakistan should implement firm policies especially for RIPPs. Country is also lacking in Coal IPPs so there is need of fuel switching in existing IPPs.

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Chapter 5

Policies and Strategies for Ensuring Positive Role

5.1. Energy Market Integration (EMI)

This includes the power trading across borders. In general, energy market integration helps in decreasing the pressure on demand as it stabilizes the demand shock and also decreases income elasticity and increases the price elasticity in long run. Partial integration (cross-border power trading) can also reduce substantial cost. For reference, the literature tells that vertical integration is associated with economy of scope, allowing competition in wholesale and retail markets which tends to improve firm efficiency and service quality results in higher productivity and consequently lower prices hence net impacts tend to be positive. Market integration goes with internal reforms and international coordination of regulations standards. Pakistan can go for EMI with India and China focusing on electricity sector as both the countries are rich in generation capacities and will agree upon the idea of EMI.

5.2. Renewable Transition

Owing to global climate change and geopolitical uncertainty in supplies of primary energy, transition of renewable is of prime importance i.e. solar, wind, biomass and hydro power. Pakistan has a rich potential of solar, wind, and hydro power so there must be policy implications regarding renewable energy and renewables must be promoted so that it can play vital role in economy and can also help in minimizing demand and supply gap along with sustainability.

5.3. Supply Diversification

Pakistan should better diversify its energy mix. This can initially be done by importing clean coal, which is often cheaper than imported oil and gas and then further by using local coal and shifting to coal will also set new trends for local coal markets and mining would be promoted as well.

5.4. Energy Security Program

Energy security is more vital than sustainability, affordability and safe supply. It is a multidimensional concept that includes both external and internal action. Economic, political and security measures must be implemented in combination for making the necessary synergies. Thus it is an integrated approach, which combines different aspects of energy security. Pakistan should work on launching an energy security program on high priority basis to cut down import bills and shift reliance on local coal.

5.5. Leadership Support

Any reforms in the Energy Sector can only be done by sincere leadership support, so leaders must be focused on resolving the issue of energy crisis by practical and positive policy implications. This can only be done when people choose their leader who is interested in taking out country from dark ages.

5.6. Generation

Authorities in charge should also make improvements on the energy-demand side, such as by aiming to reduce by half the 30% in losses arising from distribution and transmission (a goal that will entail crackdowns on energy theft). This will surely help in minimizing existing crisis.

5.7. Hydro

Development of hydropower is not only a cost effective option for Pakistan but is also source of livelihood for unskilled and semi-skilled personnel and also private sector should be encouraged in this sector as hydro IPPs are rare in country, this will help the country for fighting electricity crisis on long term basis.

5.8. Balanced Energy Mix

Adoption of a balanced energy mix in combination with the development of hydropower in Pakistan has the potential to change the fate of Pakistan energy sector and bring around the golden era in Pakistan. At this time 65% of electricity is being generated by thermal and most fuel is being imported so there is need to create a balance in energy mix for sustainability.

5.9. Efficiency Enhancements

An area that needs attention is increment in the energy efficiency of existing thermal power plants that are energy guzzlers in the country moreover cogeneration (combined heat and power) plants can effectively mitigate the energy shortage through co-feeding of coal, biogas, biomass and ethanol to existing Gensets.

5.10. Revision of Renewable Policies

There is need for revising renewable energy policies that should promote private investors in this sector as renewable promotion will help in sustainability.

5.11. Guarantees for FDIs

GoP should provide explicit guarantees to Foreign Direct Investments in electricity sector by supporting in tariffs and PPA (Power Purchase Agreements). This will support foreign investments at ease and will help the nation to meet challenges regarding electricity shortage.

5.12. Wind Sector

This graph shows the proposed wind plan from 2007 to 2029. It can be seen on graph that AEDB was supposed to generate approximately 2000 MW in 2014 but the actual installed capacity by 2014 was less than 100 MW. This shows poor performance of AEDB, moreover, the grid just allows 5% of wind energy. Pakistan should promote investments in wind sector by offering better power purchase settlements.

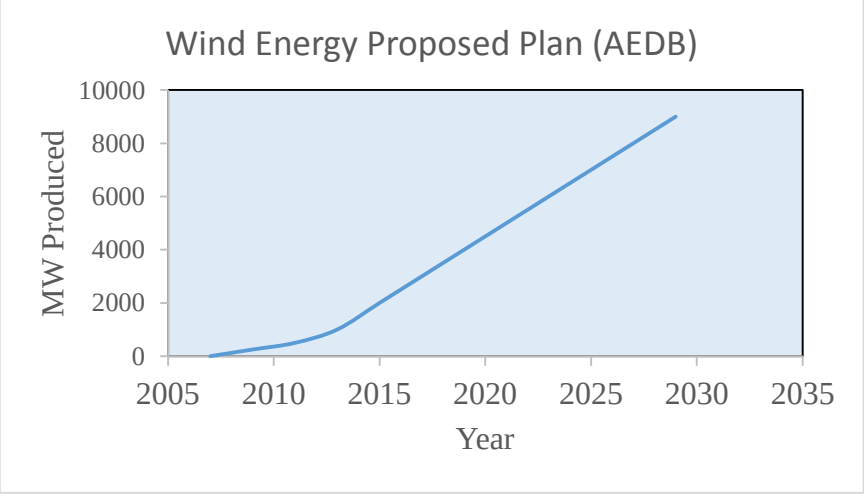

Figure 5.1: Wind proposed plan (AEDB)

5.13. Private Public Partnership

Private investors look reluctant in partnership with government unlike other countries of where PPP are sharing a lot in development. In Pakistan, the government doesn't look very much interested in PPP as well as investors also feel reluctant due to previous histories of corruption.

5.14. Single Buyer Monopoly

Independent Power Producers in many countries undergo this problem as there is no option for selling electricity except government and thus there is no competition in selling electricity and IPPs sell electricity at marginal tariff.

5.15. Decentralized Generation

Centralized generation has not been liked anywhere in the world as there are a lot of line as well as other losses involved, so policy must brush up towards decentralized generation which would cater other technical flaws of system e.g. allowance of specified amount of electricity in the centralized grid and prevention of power losses from small scale generations.

5.16. GENCOs Restoration

There is literal need for increasing efficiencies of GENCOs as India has Renovation and Modification Policy of existing power plants since 1995. In such policies, Government can allow private sector to enhance the performance of existing GENCOs and let them take extra generated units of electricity for a specified period, as practiced in India. This would be a very good initiative towards minimizing electricity crisis and short term solution without tiresome labor.

5.17. Transmission & Distribution

T&D in Pakistan should also be privatized as India allows FDI in transmission and distribution, which makes stockholders comfy as they can sell directly to consumers. This would also eliminates single buyer monopoly and will help in efficient transmission with minimum loss.

5.18. Redirecting Fuel

In year 2013, Rs. 13 billion/month were spent on GENCOs for producing 650 MW while Rs. 10 billion/month were spent on IPPs and 1150 MW electricity was produced. Hence just by redirecting fuel from GENCOs to IPPs Rs. 3 billion can be saved and 500 MW can be generated, so Government should make some policies that must start the barred IPPs which are closed due to circular debt and other financial mismanagement and that are still more efficient than GENCOs.

5.19. FIT Policy

Feed in Tariff Policy encourages the growth of domestic and small scale renewable energy industry. Government should promote FIT by guaranteeing the payments for the produced energy from renewable sources such as solar, geothermal, wind and other recourses.

Summary

At this time Pakistan needs policy implication in the field of Energy and energy security is most important thing at this stage along with introduction of renewable resources, this will help country to get out of the dependence on imported fuel. Pakistan should also focus to promote micro hydel and domestic solar energy by implementing Feed in Tariff (FIT) Policy. In the existing power plants, Government should take steps to enhance the efficiencies of GENCOs. On short term basis, focus must be on transmission and distribution losses which are greater than world average. In hydel energy, Pakistan needs private investments and the policies aren't supporting for private investments as well as for Private Public Partnership (PPP).

Annexure I

Current Scenario of Independent Power Producers in Power Sector of Pakistan

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Abstract

Country is facing severe shortfall of electricity since two decades so to minimize this issue private investors were welcomed power sector back in 1990's. After formation of 'Power Policy 1994' foreign investments were appreciated and operation in this sector started in 1997. After commercial operations of IPPs there was a tremendous increase in generation capacity and it was enhanced to 74% just in 5 years. Electricity was totally sold to WAPDA under 25 years PPA (Power Purchase Agreement). Until now there are almost 30 IPPs in operation and contributing nearly 37% in Country's electricity generation. Until now all IPPs are thermal and most are consuming RFO (Residual Fuel Oil), few are Diesel based and rest are using Natural Gas. This paper highlights share of IPPs in electricity sector of Pakistan, risks and problems met by IPPs and tariff mechanism for IPPs.

Keywords: Independent Power Producers; IPPs in Pakistan; IPPs risks; IPPs problems; IPPs tariff mechanism.

1. Introduction:

Electricity is taken as life line of every economy and one of the vital tool of socioeconomic growth of a state. As a result of Industrial development and population growth the demand of electricity has been increased in comparison to development in electricity production in Pakistan. Supply is far less than demand that is the reason of blackouts in the Country. Electricity infrastructure of Pakistan is underdeveloped and poorly managed. Presently severe Energy crisis are being faced by the Country. In spite of strong economic growth and rising energy demand during past decade, there is a little growth in generation capacity. Furthermore, rapid growth in demand, transmission and distribution losses, and seasonal declines in the hydropower has made situation worse. So the demand surpasses supply and thus power cut down becomes common phenomenon. The crisis worsened in 2008 when shortfall reached around 4000 MW and surpassed 7000 MW in 2011[1]. Industrial customers met power shortage due to low water level in dams while electricity prices are continuously being increased. This results a great loss to industrial sector people lose their jobs even. Electricity Sector of Pakistan comprises Generation, Transmission and Distribution. Generation is a mix of hydel and thermal divisions controlled by two vertically unified utilities WAPDA (Water and Power Development Authority) for all Pakistan excluding Karachi and KESC (Karachi Electric Supply Corporation) for Karachi and nearby[2]. There are several IPPs (Independent Power Producers) that share in electricity generation in country. For a long time, the problem of corresponding Pakistan's generation compared to the demand for power has remained an unsolved matter. Total electricity installed capacity in Pakistan till June 2013 is 23,617 MW in which share of WAPDA Hydro Power is 6733 MW, Thermal (GENCOs) are sharing 7182, Nuclear is sharing 787 MW, IPP hydro are contributing 195 MW and IPP thermal are sharing 8670 MW along with 50 MW Wind[3]. Country is still facing an extensive challenge in making over its system in authority for the supply of electricity. Because of an impractical tariff, inefficiencies, small payment recoveries and the failure of the government to manage its subsidies structure that lead to a serious “Circular Debt” issue which is becoming a hurdle for upcoming investments in power sector. The economy is being affected seriously by power crisis with loss of enormous capital. The abrupt solution to the present crisis lies in energy management at

all levels in country. The practice of alternate energy e.g. Wind and Solar Power could be utilized to instantly cut the shortages, while power projects from coal and hydel can provide a lasting solution to the power shortage.

2. IPP Sector in Pakistan:

In Pakistan IPPs share a lot in energy mix and it is about 37% of the installed generation capacity. IPPs were started under 'Power Policy 1994' and the era of 1992-1996 was of IPP boom in Asia. After start of commercial operation of IPPs in 1997 the generation capacity was enhanced up to 74% in just 5 years[4]. Independent Power producers adds considerably in power generation but unfortunately the energy which is being produced is below capacity because of operational capital unavailability caused as a result of unpaid receivables from PEPCO. Like other countries, IPPs in Pakistan also faces sole purchaser marketplace. Power from IPPs is sold to WAPDA (Water and Power Development Authority) and KESC, these are sole buyer of electricity from IPPs[5]. A tariff from IPPs is negotiated with the regulator NEPRA under the transparent competitive bidding procedure[6]. Investors are normally insulated from fundamental financial hazards by signing long term PPA (Power Purchase Agreement) with take-or-pay agreements supported by explicit guarantees from government and credit enhancements. The key role of the framework is to avoid the maximum risks borne by the Project Firm. A fundamental assumption is to obey the terms of their contracts of all parties.

3. Risks met by IPPs in Pakistan:

3.1. Economic Risk:

Economic risk factors are exchange rate fluctuations, inflation and budgets of finance.

3.2. Market Risk:

IPPs can sell generated power to single customer only i.e. WAPDA. This prescribed procedure exposes IPPs to the risk of single customer. Though there are guarantees given by Government to pay off the IPPs for defaulting of WAPDA on payments and the recent crisis of IPPs reflects unwillingness of Government to honor guarantees on appeal that WAPDA could not manage to pay for outstanding IPP dues.

3.3. Political Risk:

It states the guarantees to IPPs by government by Implementation Contract. Because of political instability, nationalization polices in the past and other similar problems, foreign investors are reluctant to invest. The low level of FDI inflows could be attributed to political instability[7].

3.4. Budget Overrun Risk:

During the construction period of a power plant, one of the greatest risk arises when financers are supposed to make available all the funds up to completion of the project including all the inflated costs between financial closure and project completion[8].

4. Problems with IPPs in Pakistan:

Two main problems faced by IPPs in Pakistan are:

4.1. Unavailability of short-term liquidity:

IPPs are mainly facing the problem of unavailability of short-term liquidity[9]. Many proposal from the advisory council of IPPs have been presented to the banks for working capital limits allocation.

4.2. Circular Debt:

One of the major problems with IPPs at this time is Circular Debt. Government is unable to make available funds to DISCOs (Distributing companies) and thus DISCOs are unable to pay IPPs which in order couldn't make payments to fuel merchants, this is inter-corporate circular debt. At the end of fiscal year FY2011 circular debt was estimated to be Rs537 billion while at the end of FY 2012 it was estimated to be Rs872 billion representing approximately 4% of the national nominal Gross Domestic Product (GDP)[10]. Most of the IPPs purchase RFO and diesel fuel from PSO (Pakistan State Oil) for electricity production but it has become problematic because of lack of working capital. The PSO is also in the loop of the inter-corporate circular debt as it imports and supplies RFO and Diesel fuel from national refineries to IPPs and GENCOs as well.

5. The IPP Tariff:

The tariff charged by IPPs to WAPDA is figured out from a formula that comprises the fixed and variable costs components. Tariff comprises of two main costs i.e. Capacity Purchase Price and Energy Purchase Price[9].

5.1. Capacity Purchase Price:

Capacity Purchase Price or CPP is the fixed component and it comprises:

vi. Debt payments of project including interest principal
vii. ROE (Return on Equity)
viii. Operation and Maintenance fixed elements
ix. Plant insurance cost
x. Insurance cost of Forex risk

5.2. Energy Purchase Price:

Energy Purchase Price of EPP is the variable component and comprises:

iii. Fuel cost fixed by Governmental organization and overhead the global rates with surcharge amount
iv. Operation and Maintenance variable elements

6. IPP Tariff Choices in Pakistan:

The two tariff choices offered to IPPs are upfront tariff and negotiated tariff[11].

6.1. Upfront tariff:

In this type of tariff mechanism, electricity produced by IPPs is purchased at some fixed rate without any negotiations and approvals.

6.2. Negotiated tariff:

In this mechanism, tariff is determined by NEPRA through negotiation in consultation with power producer, electricity purchaser and other stakeholder (if any). While determining the tariff, following parameters are taken into account.

iii. Technical Parameters
iv. Financial Parameters

The technical parameters include plant efficiencies, electrical efficiencies, availability factor of plant and transformation efficiencies etc. while financial parameters includes equity ratio, loan interest, return on equity (ROE), capital cost etc.

Conclusions

The GOP should indorse private investments in power sector both in thermal and renewables. At present there are no RIPPs (Renewable IPPs) so there should be some share of renewable as well for sustainability and energy security. The government should also aid the prevailing IPPs while GENCOs must be unhurriedly substituted by IPPs because of efficiency levels. There must be more fuel allocation to IPPs rather than GENCOs as by spending PKR 13 billion/month it produces 650 MW while in case of IPPs, 1,150 MW are produced by spending PKR 10 billion/months[12]. Government should also ensure guarantees for evading snags like circular debts.

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